



(11) **EP 0 921 600 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.06.1999 Bulletin 1999/23

(51) Int. Cl.⁶: **H01R 13/506**, H01R 13/627,
H01R 13/703, H01R 13/639

(21) Application number: 98309971.4

(22) Date of filing: 04.12.1998

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

**(30) Priority: 04.12.1997 US 67538 P
23.11.1998 US 197748**

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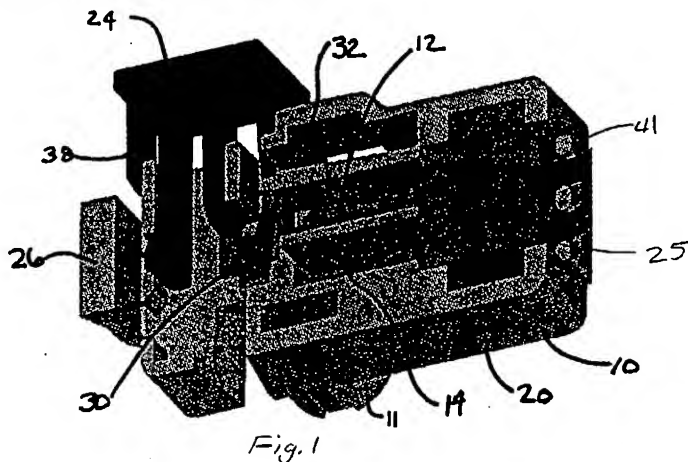
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(54) Orientationless squib connector assembly for automotive air bag assemblies

(57) An orientationless squib connector (10) for an automotive air bag assemblies is disclosed. The squib connector includes a connector configured to fit within a squib socket. A connector position assurance member (CPA) is mounted on the connector body for movement between an open position and a closed position. The CPA includes an abutment member positioned to abut against a portion of the connector body to prevent movement of the connector position assurance member

out of the open position. The CPA also includes a flexural member (30) configured to abut against the socket to deflect the flexural member and the abutment member out of abutment with the portion of the connector body, whereby the connector position assurance member is movable to the closed position to prevent removal of the connector from the socket.



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Description

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit under 35 U.S.C. § 119(e) of U.S. Provisional Patent Application No. 60/067,538, filed on December 4, 1997, entitled Orientationless Squib Connector, the disclosure of which is incorporated by reference herein.

[0002] This application is related to European Patent Application No. 97938274.4 published as No. 0869883, filed on August 11, 1997, entitled Orientationless Squib Connector Assembly for Automotive Air Bag Assemblies, the disclosure of which is incorporated by reference herein.

BACKGROUND OF THE INVENTION

[0003] Supplemental inflatable restraints or air bag assemblies are becoming increasingly common as a safety device in vehicles throughout the world. The assembly comprises an inflatable canister located in the steering column, the passenger-side dashboard, the side door panel, or seat. Upon a sufficiently great deceleration, the canister is inflated by an explosive device known as a squib which contains a gun powder-based material. The squib is fired electronically upon a signal sent via wires from a deceleration or other sensor in the vehicle. The wires are attached to the squib via a squib connector which plugs into the squib socket.

[0004] A common form of squib assembly has two pins which extend within the socket, and an associated connector has two terminals which are in electrical contact with the pins when the connector is plugged into the socket. When the connector is removed from the socket, typically for servicing the inflation canister, a shorting clip or shunt is biased into electrical contact with the two pins to form an electrical connection therebetween to reduce the risk of misfiring, for example, by static electricity. The connector urges the shorting clip out of electrical contact with the pins when the connector is plugged into the socket.

[0005] During manufacture of a two-pin squib assembly, two rotational orientation concerns must be addressed. The pins must be located at the correct clocking position relative to the connector and the squib. Also, the pins must be parallel to each other and perpendicular to the socket floor, or the entire assembly must be discarded. Also, during assembly of the vehicle, the vehicle manufacturer must be concerned about routing of the wires. A keying feature must be provided to ensure proper orientation of the assembly.

[0006] Other prior art air bag connectors are shown in U.S. Patents Nos. 5,334,025 and 5,401,180.

SUMMARY OF THE INVENTION

[0007] The present invention provides a single-pin

squib connector assembly which has no required rotational orientation. An orientationless squib connector for an automotive air bag assembly comprises a connector body having a cylindrical portion, defining a central axis, configured to fit in mating engagement within a squib socket. A first electrically conductive terminal is symmetrically located about the central axis within the cylindrical portion. A second electrically conductive terminal is radially offset from the electrically conductive terminal with respect to the central axis and comprising a depending beam having a contacting surface at a free end thereof. A cover is fixed to the connector body.

[0008] A connector position assurance member (CPA) is mounted on the connector body for movement between an open position and a closed position. The CPA includes an abutment member positioned to abut against a portion of the connector body to prevent movement of the connector position assurance member out of the open position. The CPA also includes a flexural member configured to abut against the socket to deflect the flexural member and the abutment member out of abutment with the portion of the connector body, whereby the connector position assurance member is movable to the closed position.

[0009] The connector body includes one or more latching arms having a catch thereon which fits within a groove on the socket. In one embodiment, the groove is located externally of the socket. In another embodiment the groove is located internally in the socket. To remove the connector from the socket, the latching arm is flexed to move the catch out of the groove. In the closed position, the CPA includes one or more depending arms that fit between the latching arm or arms and the rest of the connector body, preventing flexure of the latching arms and removal of the connector from the socket.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0010] The invention will be more fully understood from the following detailed description taken in conjunction with the accompanying drawings in which:

Fig. 1 is an isometric view of a first embodiment of an orientationless squib connector according to the present invention with the connector position assurance member (CPA) disengaged and the cover removed, for use with a socket having an external groove;

Fig. 2 is a partial isometric bottom view of the connector of Fig. 1;

Fig. 3 is an isometric view of the connector of Fig. 1 with the CPA engaged;

Fig. 4 is a bottom isometric view of the connector of Fig. 3;

Fig. 5 is an isometric view of the cover of the connector of Fig. 1;

Fig. 6 is an isometric view of the connector body of

the connector of Fig. 1;

Fig. 7 is a bottom isometric view of the connector body of Fig. 6;

Fig. 8 is an isometric view of the CPA of the connector of Fig. 1;

Fig. 9 is a bottom isometric view of the CPA of Fig. 8;

Fig. 10 is a top view of the connector of Fig. 1 with the cover attached;

Fig. 11 is a side view of the connector of Fig. 10;

Fig. 12 is a bottom view of the connector of Fig. 10;

Fig. 13 is a top view of the connector of Fig. 1 with the cover omitted and the CPA disengaged;

Fig. 14 is a sectional view along line A-A of Fig. 10;

Fig. 15 is a sectional view along line B-B of Fig. 11;

Fig. 16 is a sectional view along line C-C of Fig. 13 with the CPA disengaged;

Fig. 17 is a sectional view along line C-C of Fig. 13 with the CPA engaged;

Fig. 18 is a sectional view along line D-D of Fig. 12 with the lockout beam deflected by the top edge of the socket (not shown);

Fig. 19 is a sectional view along line E-E in which the lockout beam is not deflected;

Fig. 20 is an isometric view of a second embodiment of an orientationless connector for use with a socket having an internal groove;

Fig. 21 is a side view of the connector of Fig. 20;

Fig. 22 is an opposite side view of the connector of Fig. 20;

Fig. 23 is a top plan view of the body of the connector of Fig. 20;

Fig. 24 is a bottom plan view of the body of Fig. 23;

Fig. 25 is an isometric view of a cover for the connector of Fig. 20;

Fig. 26 is an isometric view of a connector position assurance member (CPA) of the connector of Fig. 20;

Fig. 27 is an isometric view of the body of the connector of Fig. 20;

Fig. 28 is a bottom isometric view of the body of the connector of Fig. 27;

Fig. 29 is a side view of the connector of Fig. 20;

Fig. 30 is a top plan view of the connector of Fig. 20;

Fig. 31 is a cross-sectional view along line C-C of Fig. 30;

Fig. 32 is a cross-sectional view along line A-A of Fig. 30;

Fig. 33 is a cross-sectional view along line D-D of Fig. 30;

Fig. 34 is a cross-sectional view along line B-B of Fig. 29;

Fig. 35 is a cross-sectional view along line H-H of Fig. 29;

Fig. 36 is a cross-sectional view along line F-F of Fig. 37;

Fig. 37 is a partial cross-sectional view along line E-E of Fig. 30 showing the connector disengaged;

Fig. 38 is a cross-sectional view along line F-F of Fig. 39;

Fig. 39 is a partial cross-sectional view along line E-E of Fig. 30 showing deflection to allow the CPA to engage in the closed position;

Fig. 40 is a cross-sectional view along line F-F of Fig. 41;

Fig. 41 is a cross-sectional view along line E-E of Fig. 30 showing the connector and CPA engaged;

Fig. 42 is an isometric view of the female terminal of the connector of Fig. 20;

Fig. 43 is an isometric view of the ground terminal of the connector of Fig. 20 prior to bending of the contacting ring into position;

Fig. 44 is a side view of a grounding clip;

Fig. 45 is an isometric view of a connector and socket assembly; and

Fig. 46 is an isometric view of a squib socket assembly.

DETAILED DESCRIPTION OF THE INVENTION

[0011] The present invention provides a single-pin squib connector assembly which has no required rotational orientation.

[0012] In a first embodiment, illustrated in Figs. 1 through 19, a connector 10 is provided for use with a single-pin squib assembly having an external latching groove around the cylindrical socket which receives the connector. In the socket, shown for example in European Pat. Application No. 97938274.4 published as No. 0869883, a first terminal is provided by a single axial pin extending along the central axis of the cylindrical socket and anchored to the initiator cup of the squib. A second terminal comprising a flat, radially extending ground plate annularly surrounds the pin and is fixed to the initiator cup within the socket. An external annular groove is provided around the socket, to which the connector attaches as described further below.

[0013] The connector includes a first or female terminal 12 comprising a pair of opposed beams which contact the pin in the socket when the connector is inserted into the socket. The connector also includes a second or ground terminal 14 having a depending beam radially offset from the pair of beams contacting the pin. A contacting ring 18 is formed at the end of the depending beam to surround the female terminal and the central pin in the socket. The contacting ring is able to contact the ground plate at any rotational orientation with respect to the socket. The terminals include wire crimp sections 60, 62 which grip associated wires 64, 66 entering the connector.

[0014] The connector includes a connector body or housing 20, a cover 22, and a connector position assurance member or CPA 24. The wire crimp portions of the first and second terminals and the associated entering wires are sandwiched between the body and the cover. The cover attaches to the connector body in any suitable

ble manner to prevent subsequent removal of the cover, such as with tabs 23.

[0015] The CPA 24 is slidable between an open position (Figs. 1, 2, 13, 16, 19) and a closed position (Figs. 3, 4, 10, 12, 15, 17, 18). A latching arm 26 extends from the connector body 20. A catch 27 on the end of the latching arm latches to the external groove in the socket. When the connector is engaged in the socket, the CPA 24 is slidable to the closed position between the latching arm 26 and the rest of the connector body, and in this position, ensures correct positioning of the connector in the socket and blocks flexure of the latching arm to disengage the catch 27 of the latching arm from the groove, so that the connector assembly cannot be removed from the socket. To remove the connector assembly, the CPA is pulled outwardly to disengage from the housing and unblock the latching arm. The latching arm is attached to the connector body with radial members 29 which flex and are configured to minimize stress on the connector body.

[0016] The female terminal includes a pad area 31 (see Figs. 16 and 17) and the ground terminal includes a flexural beam 30 biased to contact the pad area on the female terminal when the CPA 24 is not fully engaged in the closed position in the connector body. The CPA includes an arm or wedge 32 which pushes the flexural beam 30 away from the pad area 31 when the CPA is in the closed position in the connector body. In this way, when the CPA is in the open position, the terminals 12 and 14 are shorted by electrical contact between the flexural beam 30 and the pad area 31. Thus, electronic diagnostic testing can be performed during assembly to determine if a short circuit exists, rather than relying upon a visual inspection to see if the CPA is fully engaged in the closed position.

[0017] In this embodiment, the CPA also includes an arm 34 which abuts against an end of a lockout beam 36 on the connector body when the connector is not inserted into a squib socket, preventing the CPA from being pushed into the closed position with respect to the connector. When the connector body is inserted into the squib socket, the top edge of the socket contacts the lockout beam 36, pushing it up and out of abutment with the arm on the CPA. Once the lockout beam no longer abuts against the CPA, the CPA can be pushed into the closed position in the connector body.

[0018] The CPA includes another arm 38 which fits between the upwardly extending portion 39 of the latching arm 26 of the connector body, preventing the upwardly extending portion from being pivoted toward the wire entrance area 41 to unlatch the latching arm 26. In this manner, the CPA in the closed position prevents the connector body from being removed from the socket. Also, the CPA includes a pair of sliders 44, 46 which slide within a slot area 48 within the connector body 20. Protrusions 50, 52 on the sliders abut against faces on the connector body to limit travel of the CPA between the open and closed positions and prevent the

CPA, once installed, from being fully removed from the cover.

[0019] A further embodiment of an orientationless single-pin squib connector assembly for use with a single-pin socket having an internal annular latching groove is illustrated in Figs. 20 through 46. The connector assembly includes a connector 110 having a depending cylindrical portion 112 for insertion within the socket 114 (see Figs. 45 and 46). In the socket, a first terminal 116 is provided by a single axial pin 117 extending along the central axis of the cylindrical socket and anchored to the initiator cup of the squib. A second terminal 118 comprising a grounding clip annularly surrounds the pin and is fixed to the initiator cup within the socket. When the connector is not inserted into the socket, the grounding clip is biased upwardly such that it makes electrical connection with the axial pin. When the connector is inserted into the socket, it pushes the grounding clip out of electrical contact with the axial pin. An annular groove 120 is provided internally within the socket to which the connector 110 latches, described further below.

[0020] The connector includes a first or female terminal 122 comprising a pair of opposed beams 124 which contact the pin 117 in the socket 114 when the connector is inserted into the socket. The connector also includes a second or ground terminal 126 having a depending beam radially offset from the pair of beams contacting the pin. A contacting ring 127 is formed at the end of the depending beam and bent from the position shown in Fig. 43 to surround the female terminal and the central pin in the socket. The contacting ring is able to contact the grounding clip 118 at any rotational orientation with respect to the socket. The terminals include wire crimp sections 128, 130 which grip associated wires 132, 134 entering the connector.

[0021] The connector includes a connector body or housing 136, a cover 138, and a connector position assurance member or CPA 140. The wire crimp portions 128, 130 of the first and second terminals and the associated entering wires 132, 134 are sandwiched between the body 136 and the cover 138. The cover attaches to the body in any suitable manner to prevent subsequent removal of the cover, such as by apertures 142 which receive tabs 144 on the body. A ferrite bead 146, as is known in the art, surrounds the wires 132, 134 in a suitably sized recess in the connector body 136.

[0022] Two latching arms 150, 152 extend from the connector body 136. Catches 170, 172 protrude from the latching arms to latch to the internal groove 120 in the socket. The latching arms are attached to the connector body with flexure members 153, 155 which flex to allow the upper portions 157 of the latching arms to be moved or flexed inwardly toward the center of the connector. When the upper portions are so flexed inwardly, the catches are displaced out of the groove and the connector can then be removed from the socket.

[0023] The CPA 140 is slidable between an open position (Fig. 37) and a closed position (Fig. 41) and is retained on the housing by catches 181 (Fig. 24). When the connector has been engaged in the socket, the CPA 140 is slid toward the wire entrance area 159 into the closed position, in which depending arms 158 fit between the latching arms 150, 152 and the rest of the connector body. In this position, the CPA ensures correct positioning of the connector in the socket, and the depending arms 158 of the CPA block removal of the latching arms 150, 152 from the groove 120, so that the connector cannot be removed from the socket. To remove the connector, the CPA is slid in a direction away from the wire entrance area 159 to unblock the latching arms, whereupon the latching arms can be flexed inwardly to disengage the catches 170, 172 from the groove 120.

[0024] The CPA 140 also includes one or more catches 154 depending from an underside of the CPA. The catches 154 fit within corresponding first notches 156 on the cover 138 of the connector body 136 when the connector is not inserted into a squib socket, preventing the CPA from being pushed into the closed position with respect to the connector. Full closure of the CPA is prevented when arms 150 and 152 are only partially mated since the arms interfere with arms 158. When the connector body is inserted into the squib socket, the top edge of the socket contacts the two depending arms 158 of the CPA 140, pushing the arms 158 upwardly and thereby displacing the catches 154 out of the first notches 156 on the cover. Once the catches no longer fit within the first notches, the CPA can be slid toward the wire entrance area 159 into the closed position in the connector body. In the closed position, the catches 154 fit within corresponding second notches 190 on the cover 138, to retain the CPA in the closed position.

[0025] The CPA 140 optionally includes a central beam 180 having a downwardly extending protrusion 182 on the end. The protrusion fits within one of two corresponding depressions or apertures 184, 186 in the cover 138, depending on whether the CPA is in the open or closed position. The protrusion 182 limits travel of the CPA between the open and closed positions and provides an audible click as it enters the depressions 184, 186, so that a user can detect when the CPA has been fully moved into either the closed or open position.

[0026] The invention is not to be limited by what has been particularly shown and described, except as indicated by the appended claims.

Claims

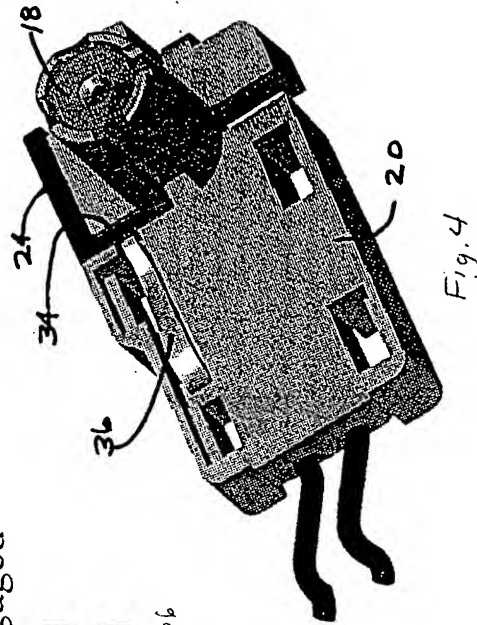
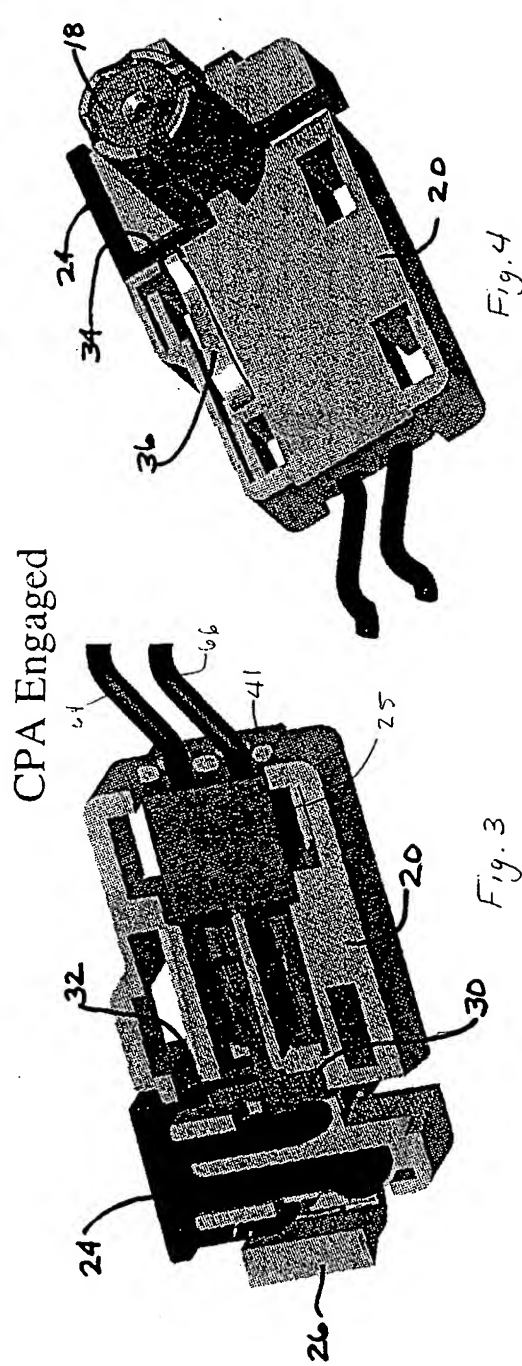
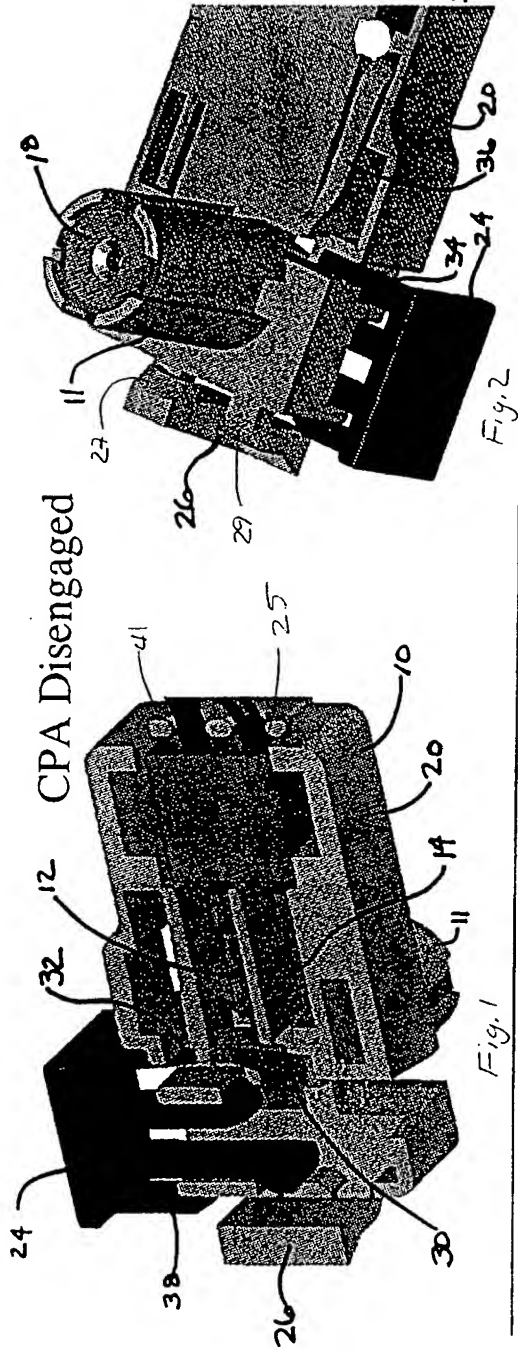
1. An orientationless squib connector for an automotive air bag assembly, the squib connector comprising:

a connector body having a cylindrical portion,

defining a central axis, configured to fit in mating engagement within a squib socket, a first electrically conductive terminal symmetrically located about the central axis within the cylindrical portion, and a second electrically conductive terminal radially offset from the electrically conductive terminal with respect to the central axis and comprising a depending beam having a contacting surface at a free end thereof;

a cover fixed to the connector body; and
a connector position assurance member mounted on the connector body for movement between an open position and a closed position, the connector position assurance member comprising an abutment member positioned to abut against a portion of the connector body to prevent movement of the connector position assurance member out of the open position, and a flexural member configured to abut against a surface of a socket to deflect the flexural member and the abutment member out of abutment with the portion of the connector body, whereby the connector position assurance member is movable to the closed position.

2. The orientationless squib connector of claim 1, wherein the connector body further includes a latching arm having a catch thereon disposed to fit within a groove of the socket.
3. The orientationless squib connector of claim 2, wherein the connector position assurance member includes a member disposed to fit between the latching arm and a remainder of the connector body when the connector position assurance member is in the closed position.
4. The orientationless squib connector of claim 2, wherein the catch on the latching arm is disposed to fit in an external groove of the socket.
5. The orientationless squib connector of claim 2, wherein the catch on the latching arm is disposed to fit in an internal groove of the socket.



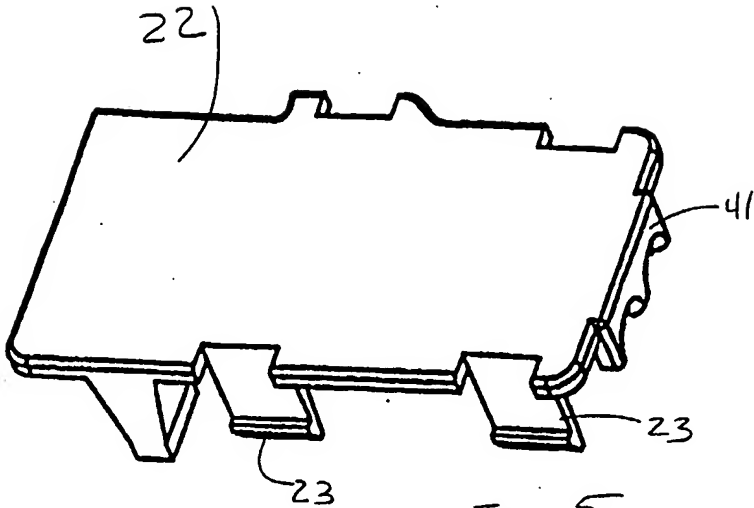


Fig. 5

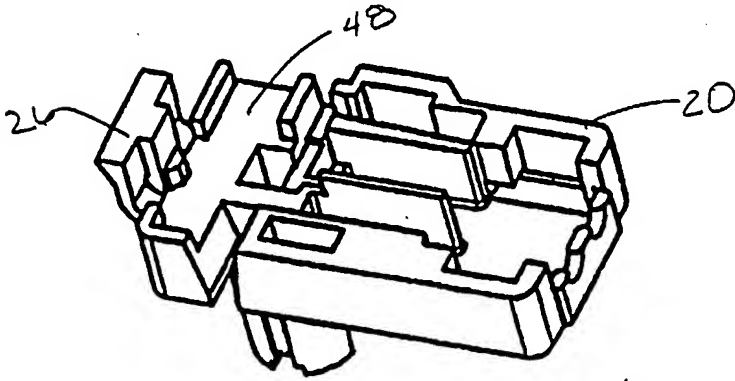


Fig. 6

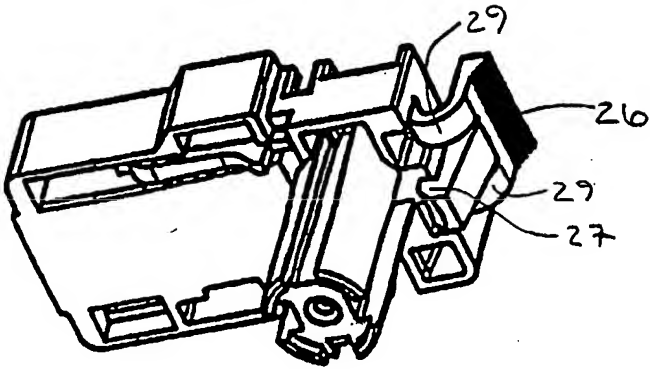
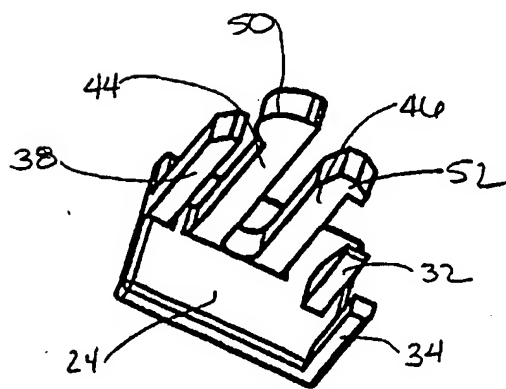
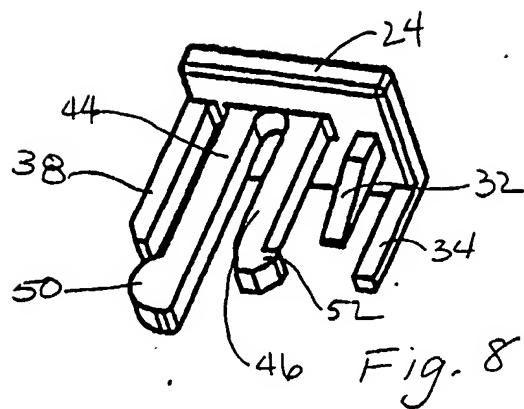


Fig. 7



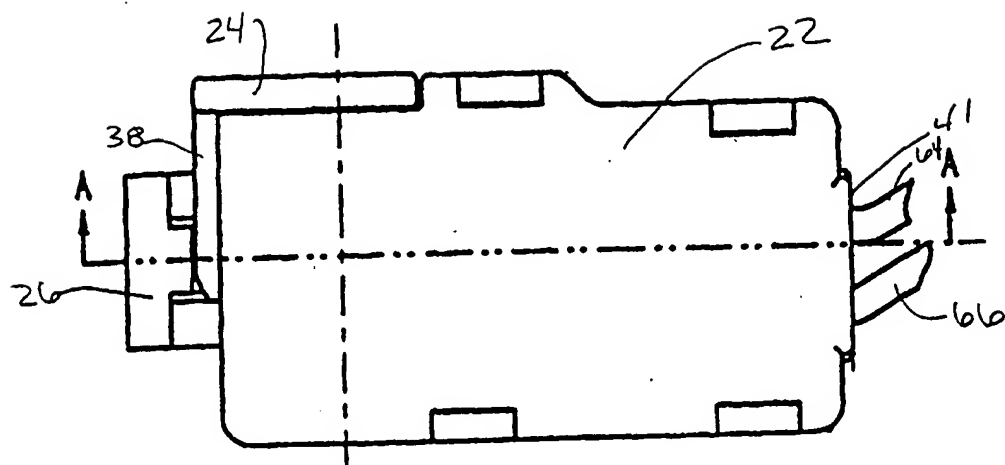


Fig. 10

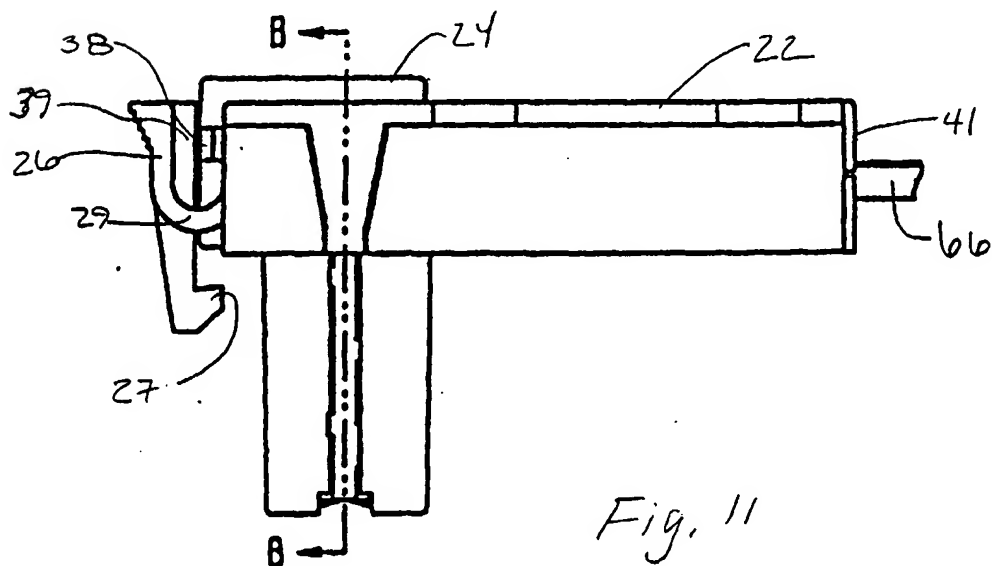


Fig. 11

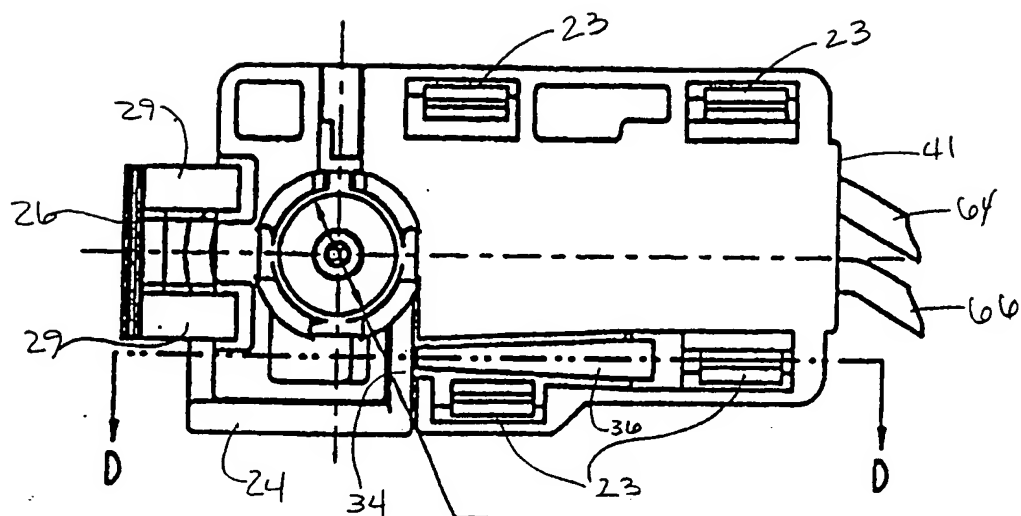


Fig. 12

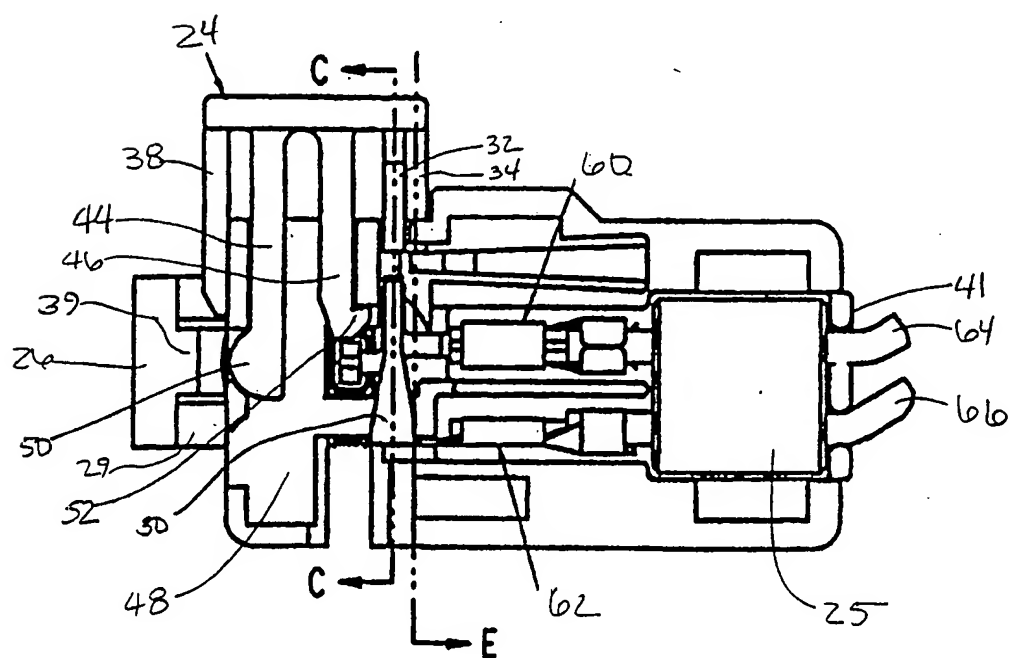
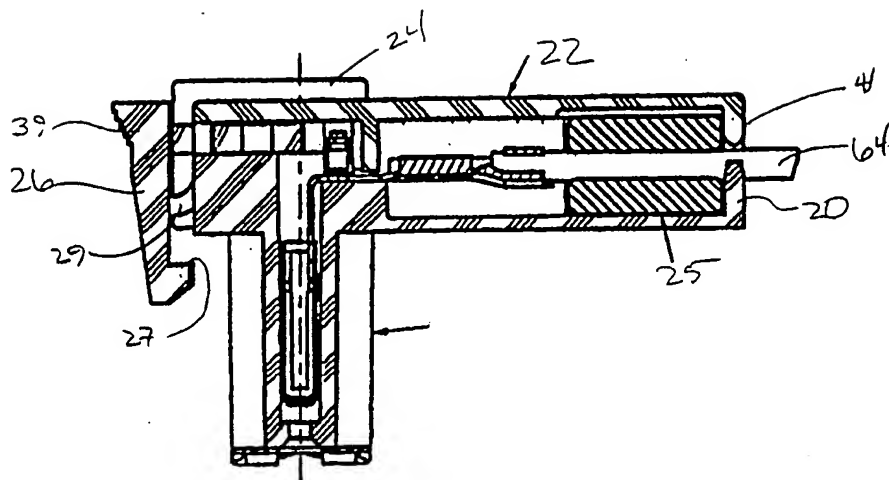
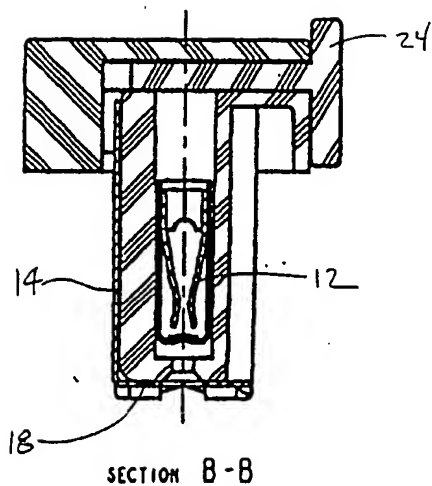


Fig. 13



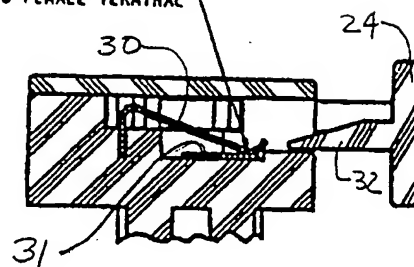
SECTION A-A
Fig. 14



SECTION B-B

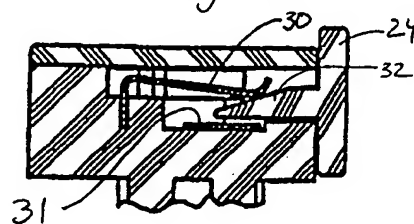
Fig. 15

GROUND TERMINAL SHORTED
TO FEMALE TERMINAL



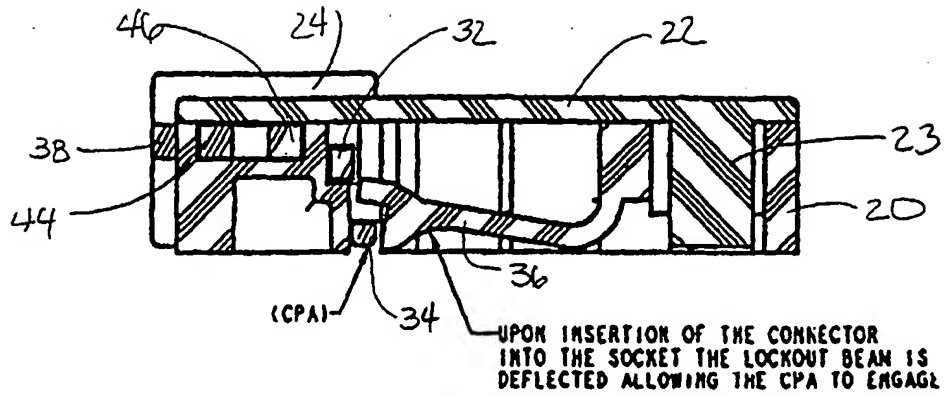
SECTION C-C
VIEW ROTATED 90°
(CPA DISENGAGED)

Fig. 16



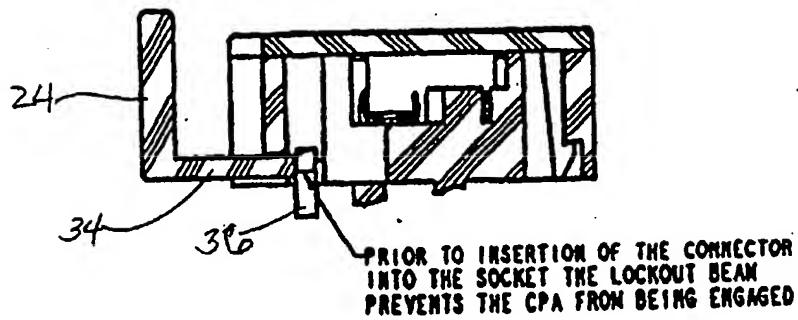
SECTION C-C
VIEW ROTATED 90°
(CPA ENGAGED)

Fig. 17



SECTION D-D
(CPA ENGAGED)

Fig. 18



SECTION E-E
VIEW ROTATED 90°
(CPA DISENGAGED)

Fig. 19

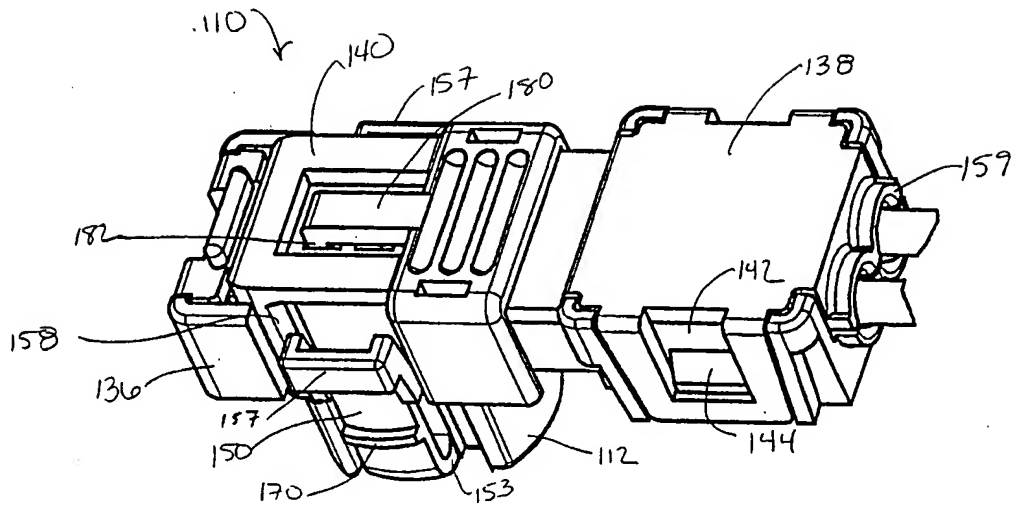


Fig. 20

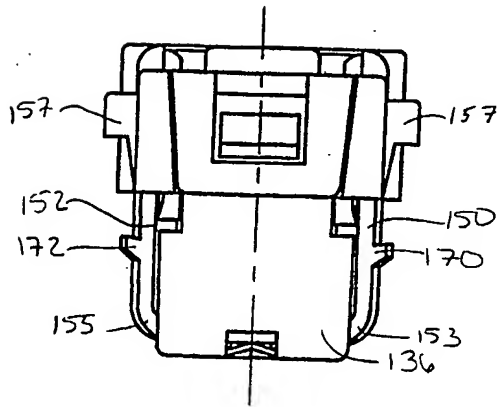


Fig. 21

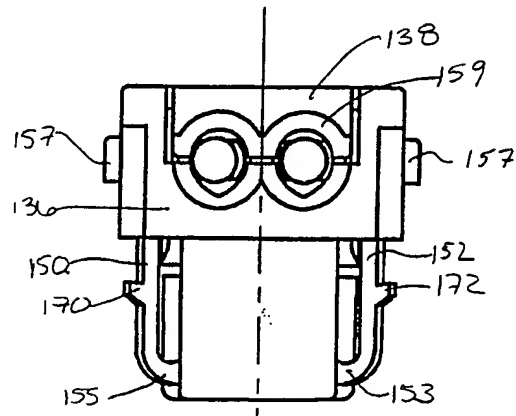


Fig. 22

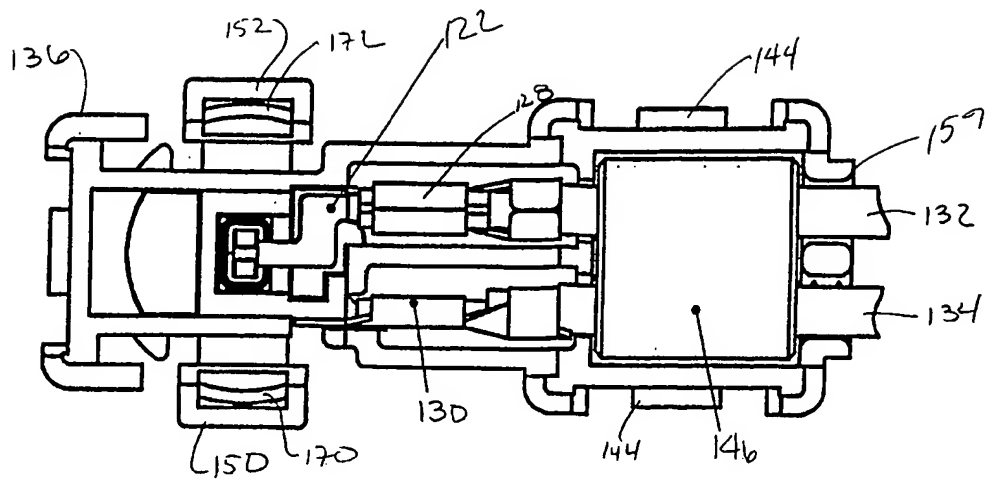


Fig. 23

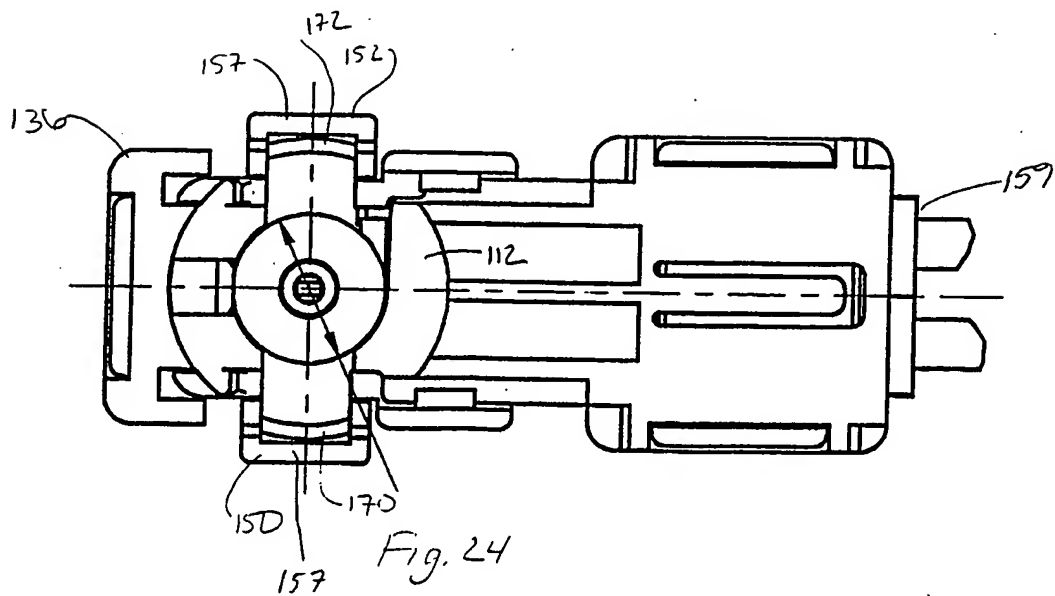
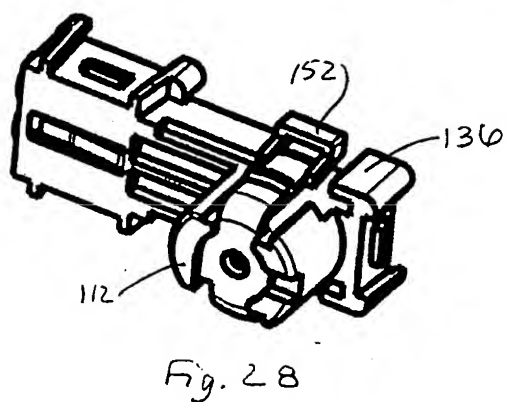
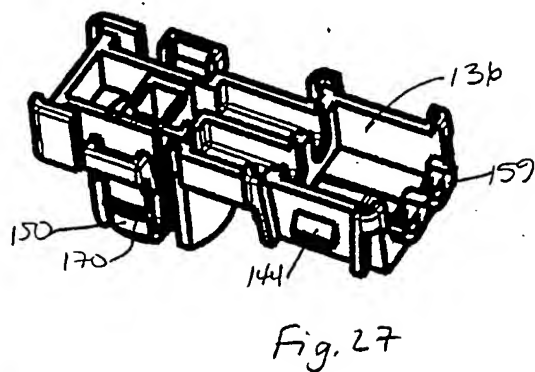
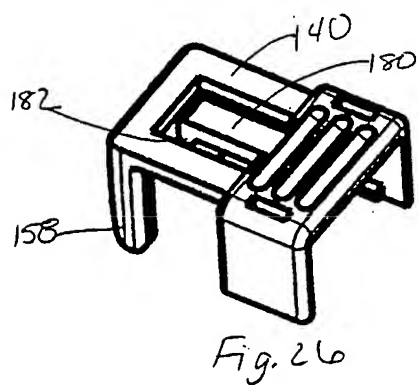
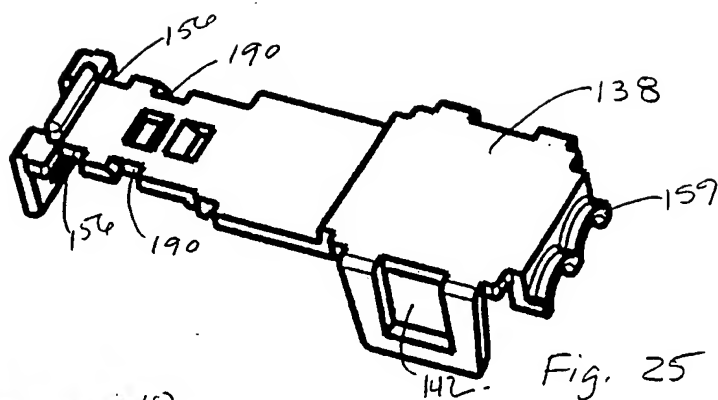
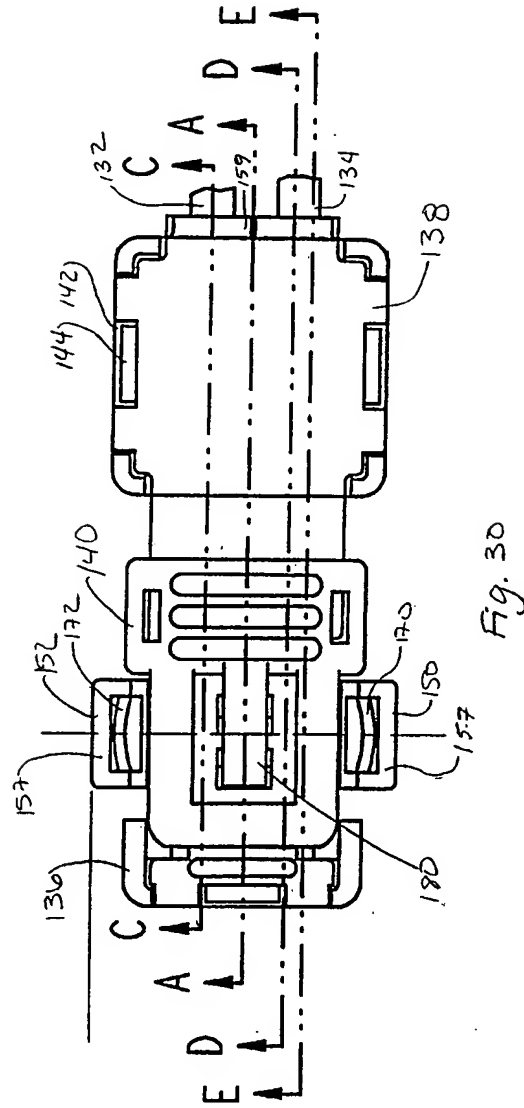
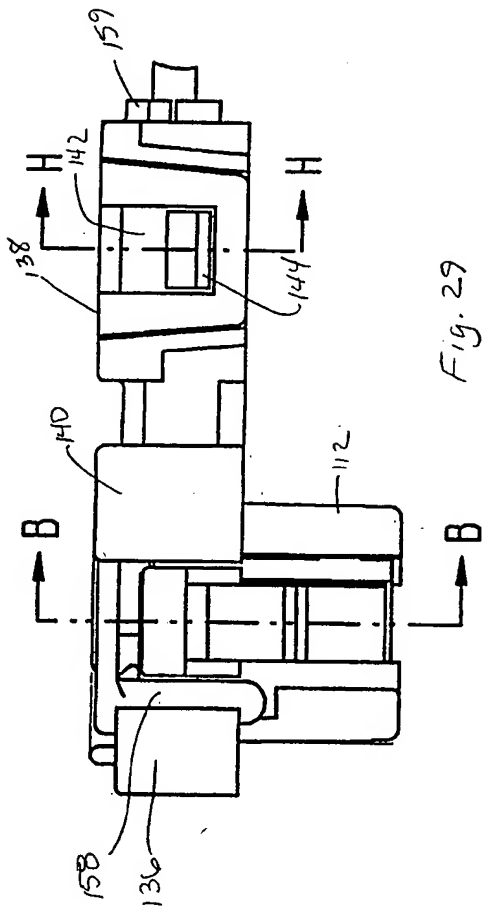


Fig. 24





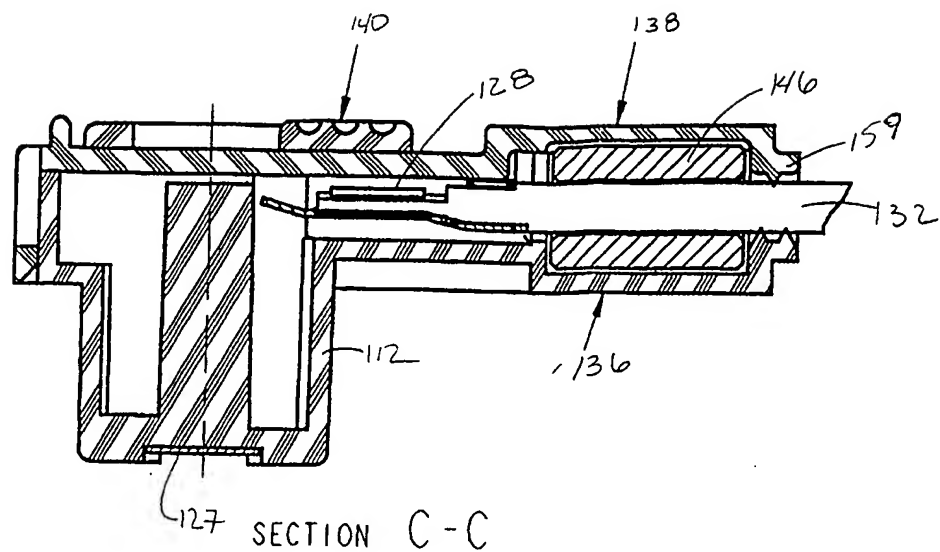


Fig. 31

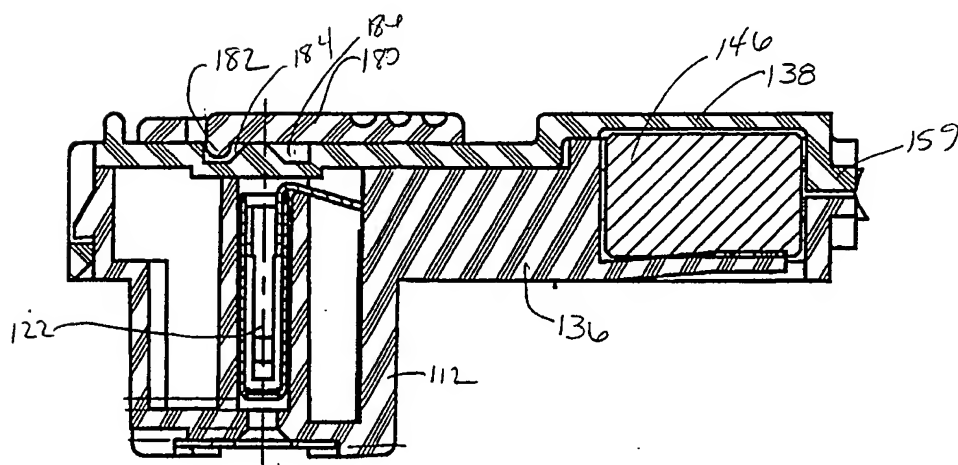
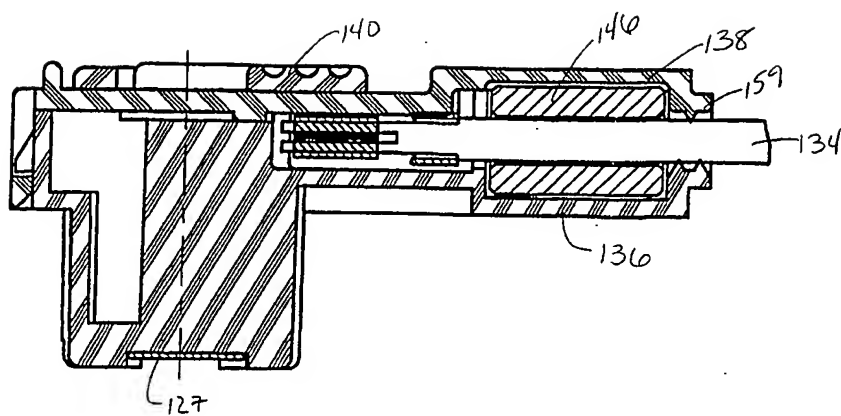
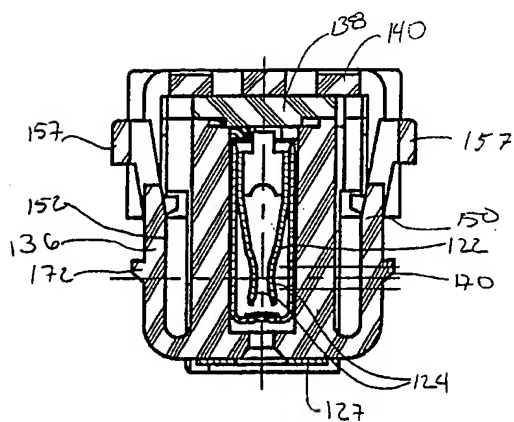


Fig. 32



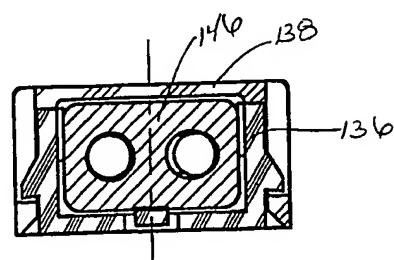
SECTION D-D

Fig. 33



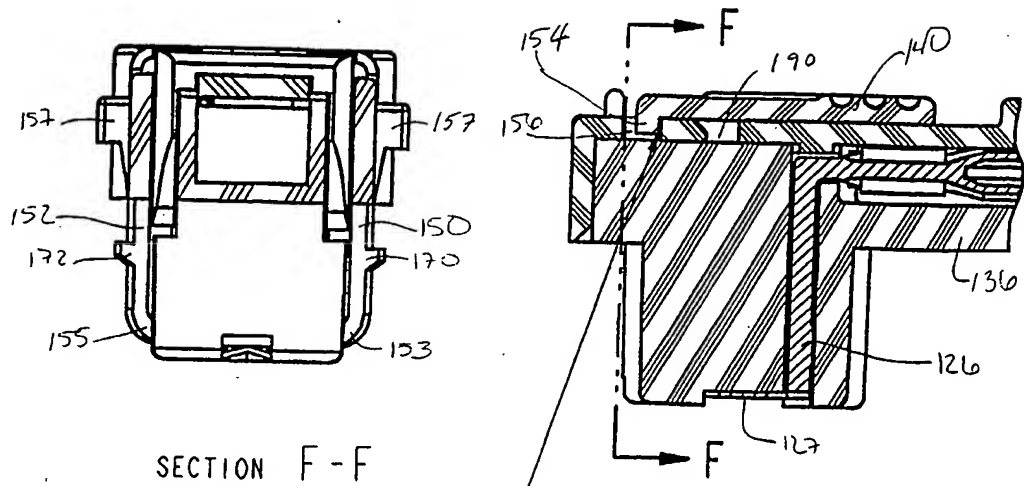
SECTION B-B

Fig. 34



SECTION H-H

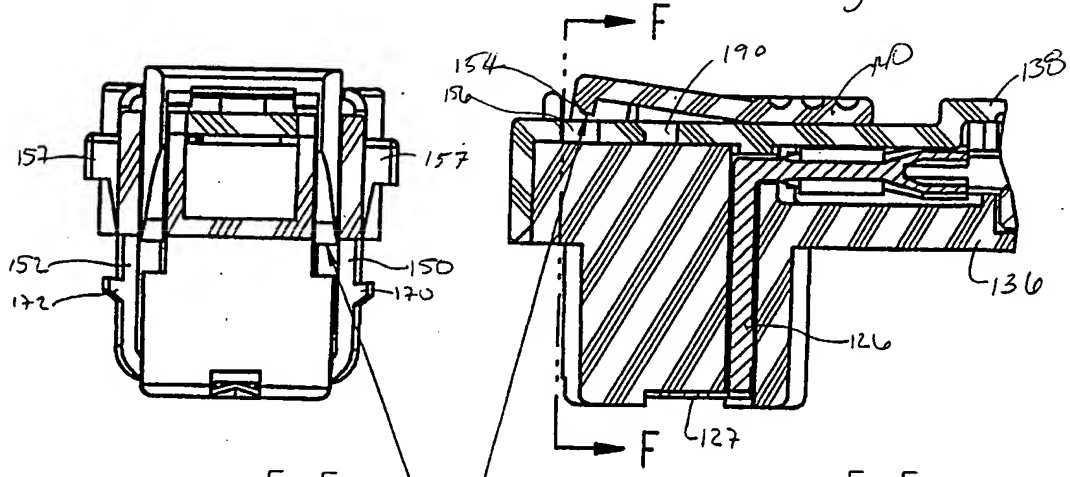
Fig. 35



SECTION F-F

Fig. 36

SECTION E-E
CONNECTOR DISENGAGED
Fig. 37



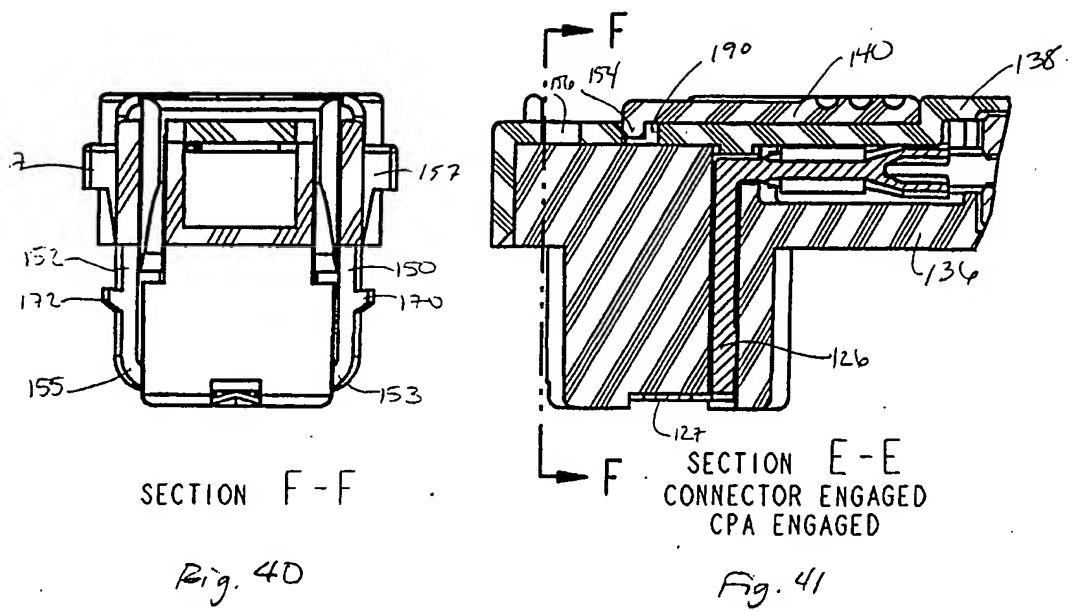
SECTION F-F

Fig. 38

SECTION E-E
CONNECTOR ENGAGED
CPA DISENGAGED

UPON INSERTION OF THE CONNECTOR
INTO THE SOCKET THE LOCKOUT BEAM IS
DEFLECTED ALLOWING THE CPA TO ENGAGE

Fig. 39



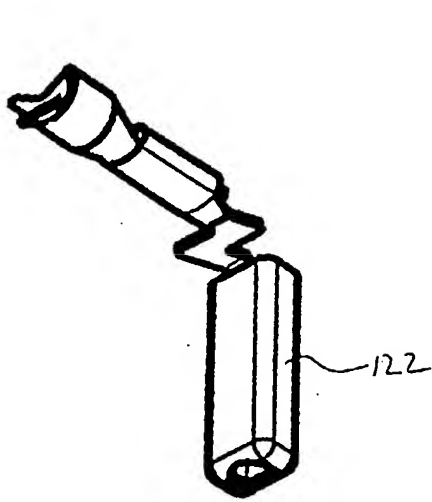


Fig. 42

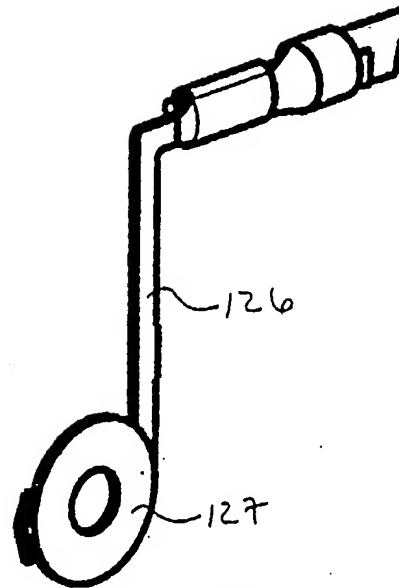


Fig. 43

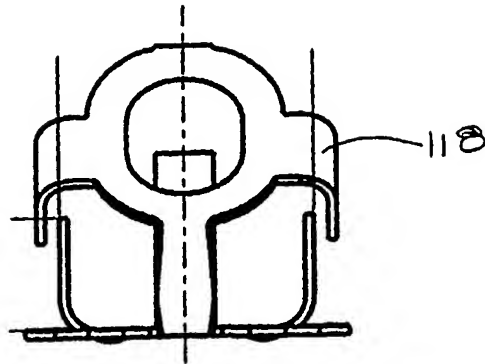


Fig. 44

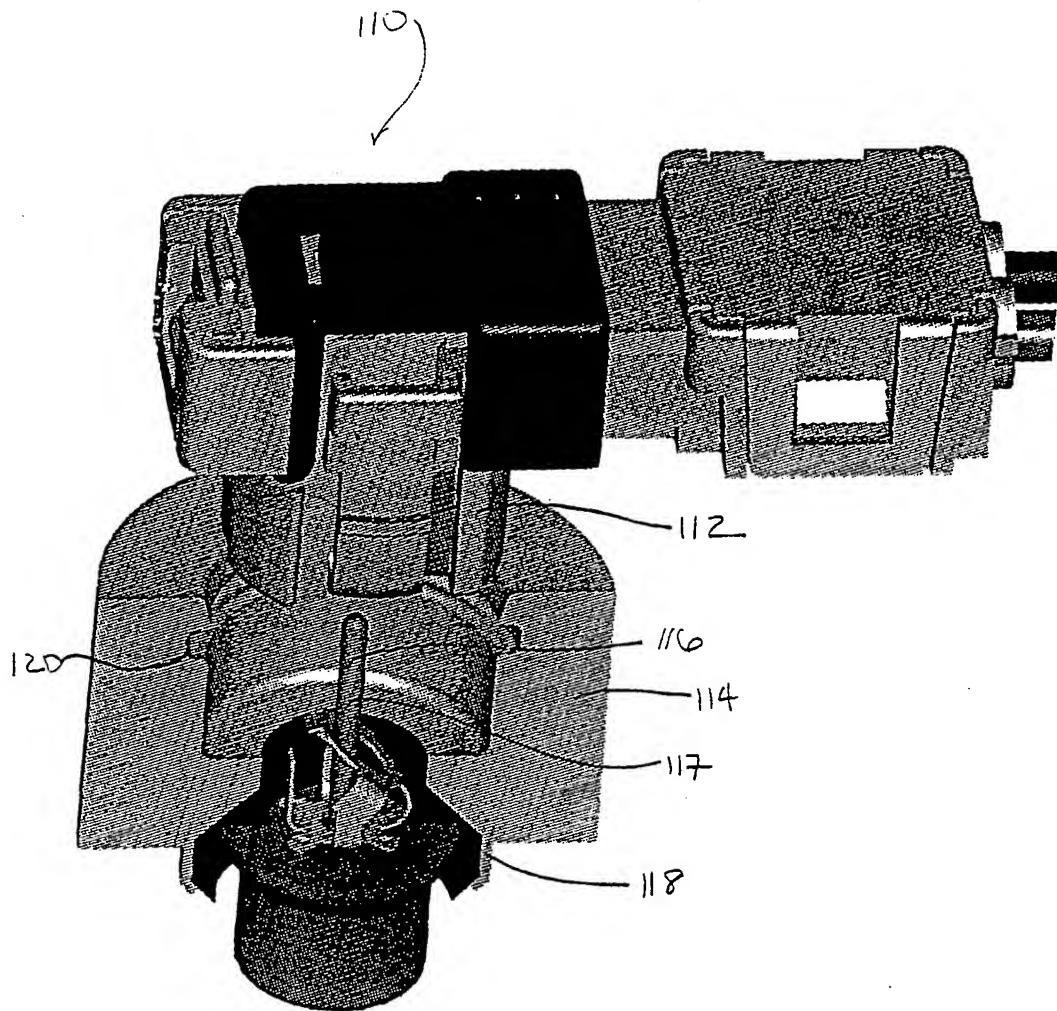


Fig. 45

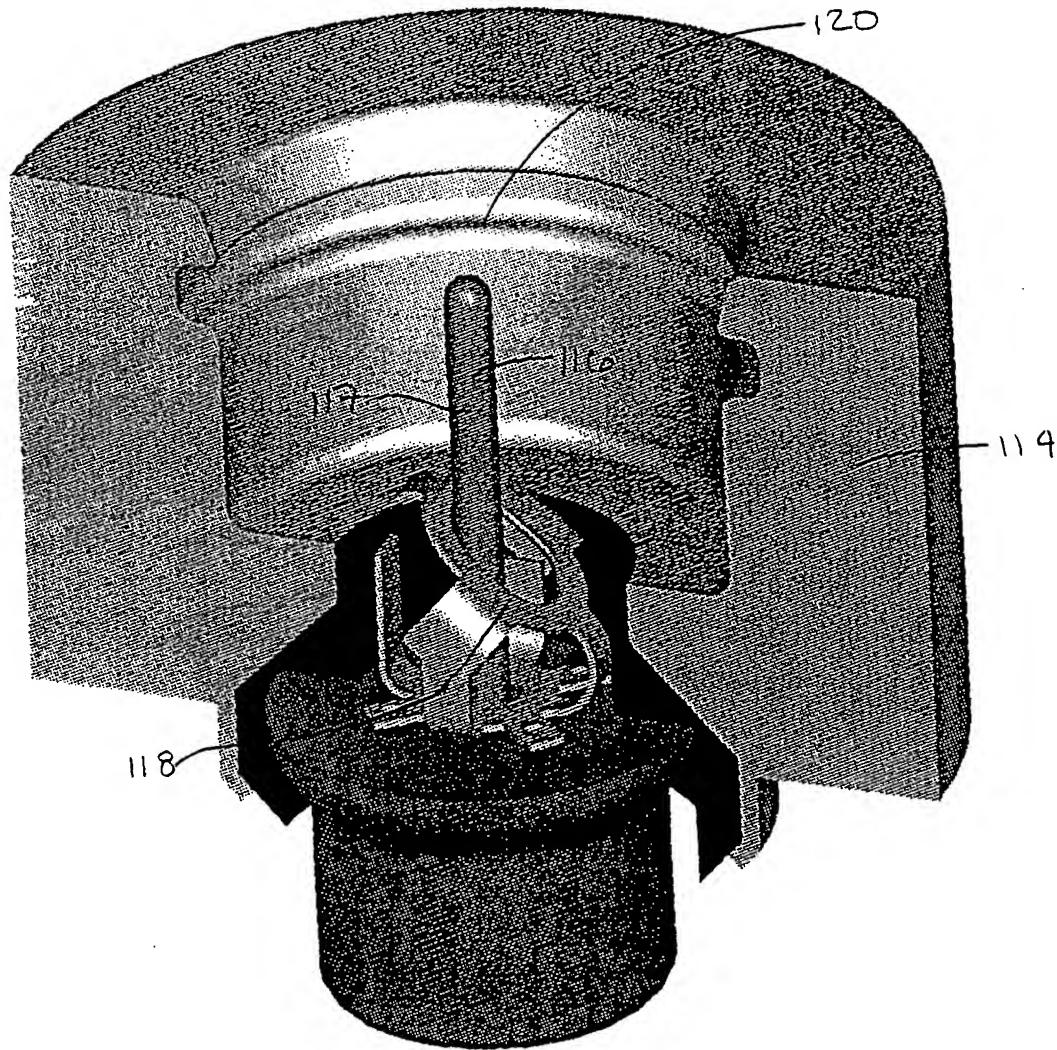


Fig. 46